Space Weather Technical Forecast

Issued on Wednesday 29 January 2025 at 01:34 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of isolated M-class flares. Chance of G1 minor geomagnetic storms from day 3 (31 Jan).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Activity has been at moderate levels, with one M-class flare in the last 24 hours, an M1.7 peaking at 28/1945 UTC from the northeast of the disc

There are currently seven sunspot regions visible on the Earth-facing side of the Sun, many of which are located near the limbs, making detailed analysis challenging. AR3967, AR3972, and AR3975 are expected to rotate beyond the western limb in the coming days. Meanwhile, AR3976 and AR3977 are emerging from the eastern limb and may correspond to the previously active regions AR3947 and AR3953 from the last solar rotation. Notably, AR3976 appears to exhibit some magnetic complexity, warranting further analysis as it moves across the solar disc. The remaining sunspots are small and magnetically simple.

No Earth-directed CMEs have been observed in the last 24 hours.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by ACE at L1, was at background levels, ranging from 280-360 km/s. Density was below average to average. The Interplanetary Magnetic Field, Bt, was mostly weak, but peaked at near 10nT at 28/1859 UTC. The north-south component, Bz, mostly varied weakly between +/-7nT. The phi angle fluctuated but was mostly negative (towards the Sun). Geomagnetic activity was mostly Quiet to Unsettled (Kp0-3).

Energetic Particles / Solar Radiation: High energy proton flux at GOES18 was at background levels.

High energy electron flux (greater than 2MeV) at GOES16 was at background to moderate levels. The associated 24-hour fluence persisted below the Active threshold, reaching 3.21e6 integrated pfu at 29/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate solar activity is expected with a chance of further isolated M-class flares, and a slight chance of X-class flares, mainly from AR3976

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Solar Wind / Geomagnetic Activity: A CME associated with a filament eruption around midnight on 26 Jan may give a weak glancing blow early on Day 1 (29 Jan), albeit this is low confidence with most of the CME expected to miss Earth. A large coronal hole, currently in the eastern hemisphere, may become geoeffective from Day 3 (31 Jan).

Quiet to Unsettled activity (Kp0-3) is generally expected through the forecast period, with a very slight chance of Active to G1/Minor Storm (Kp4-5) intervals early Day 1 (29 Jan) should any glancing CMEs arrive. An increasing risk of Active, or possibly G1 minor storm, intervals then possible on Days 3 and 4 (31 Jan-01Feb) with any connection to CH11/+ high speed stream.

Energetic Particles / Solar Radiation: There is a slight chance of enhancements exceeding the S1/Minor Radiation Storm threshold at first, should any larger flares occur from over the western limb.

GOES16 high energy electron flux is likely to show a gradual decline. The corresponding 24-hour fluence is expected to remain below the Active threshold on a declining trend.

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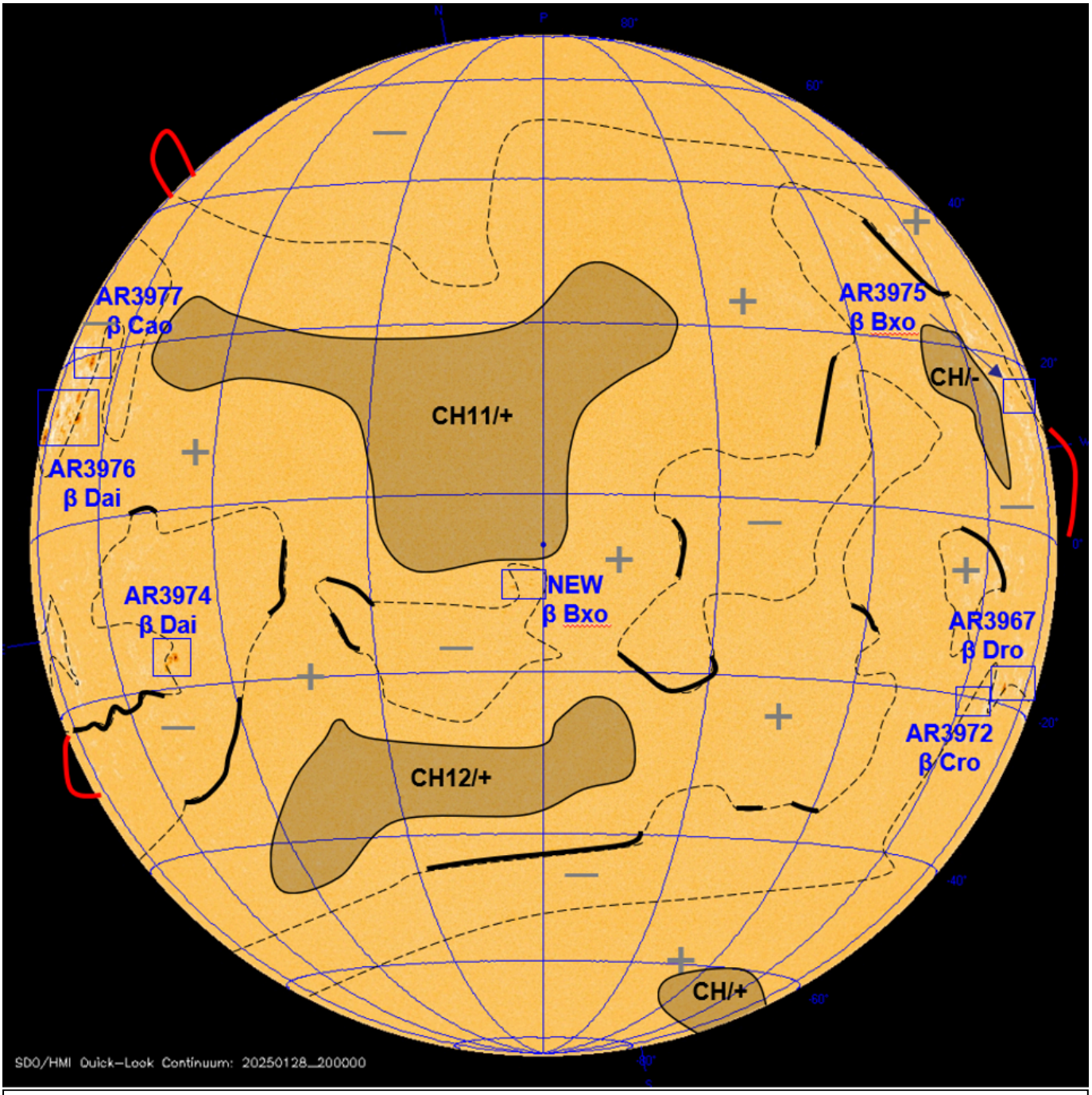
Figure 1: Solar Synoptic Map valid 28/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

No new CMEs feature in the forecast. A CME associated with a filament eruption around midnight on the 26 Jan may give a weak glancing blow early on Day 1 (29 Jan), this is low confidence however with most of the CME expected to miss Earth. A large recurrent coronal hole (CH11/+), currently in the eastern hemisphere, may connect with Earth through Day 3 (31 Jan), with winds on the previous rotation reaching Elevated levels. MOSWOC Enlil is probably too quick to connect this feature with Earth.

Quiet to Unsettled activity (Kp0-3) is generally expected through the forecast period, with a very slight chance of Active to G1/Minor Storm (Kp4-5) intervals early Day 1 (29 Jan) should any glancing CMEs arrive. An increasing risk of Active, or possibly G1 minor storm, intervals then possible on Days 3 and 4 (31 Jan-01Feb) with any connection to CH11/+ high speed stream.

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	15	10	30	30
Strong	G3	No	1	1	5	5
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

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Figure 2: Estimated planetary K index from BGS

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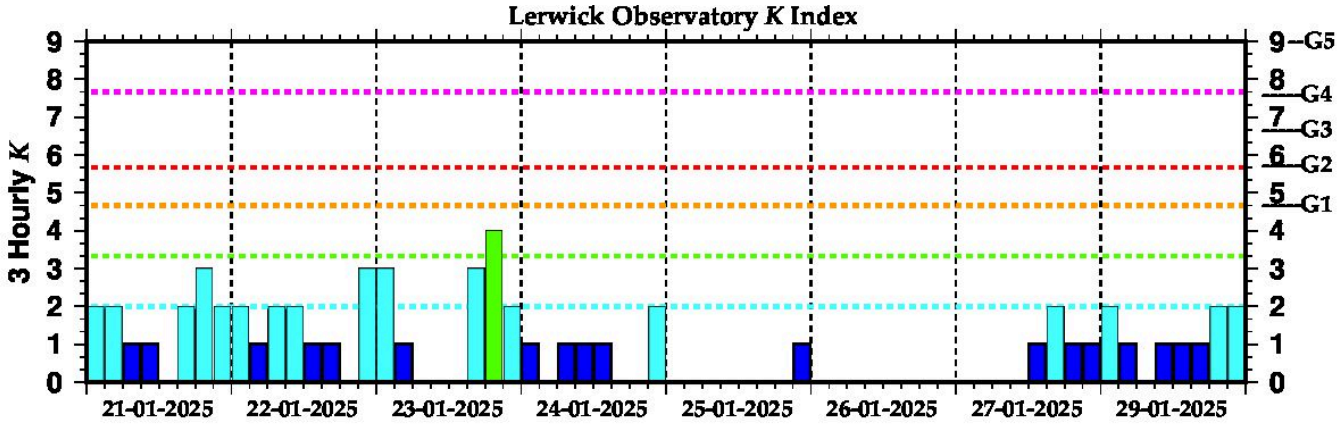

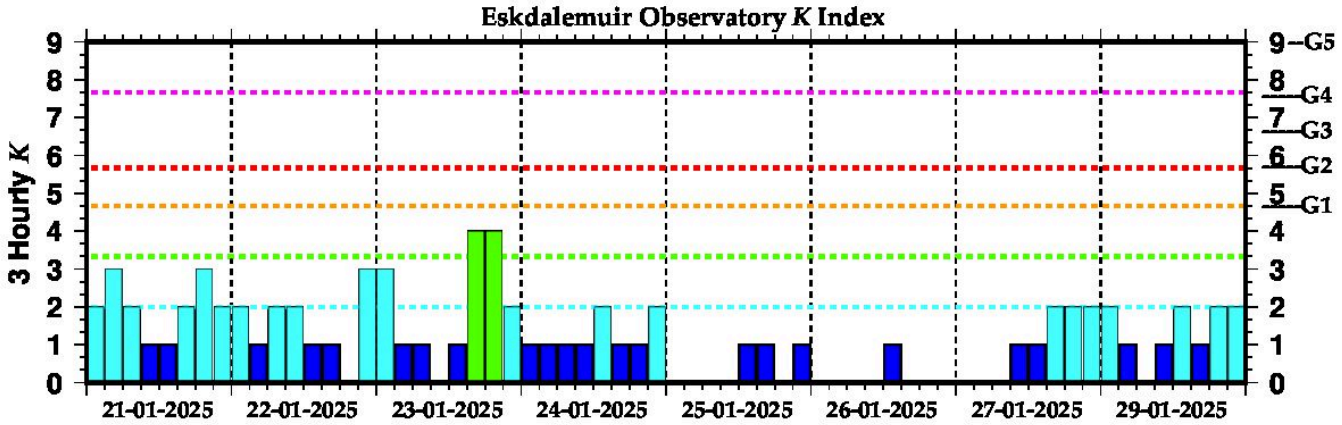

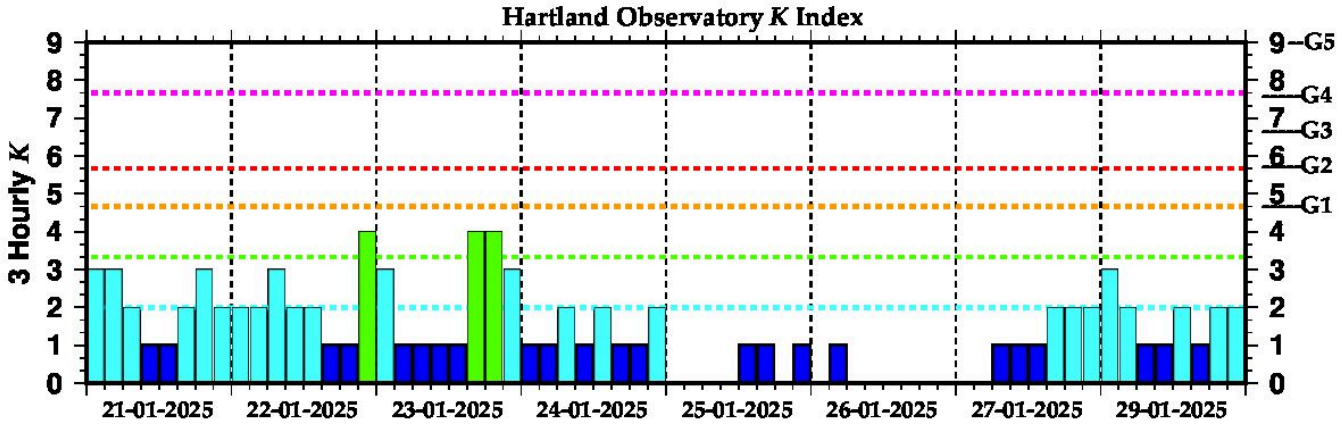

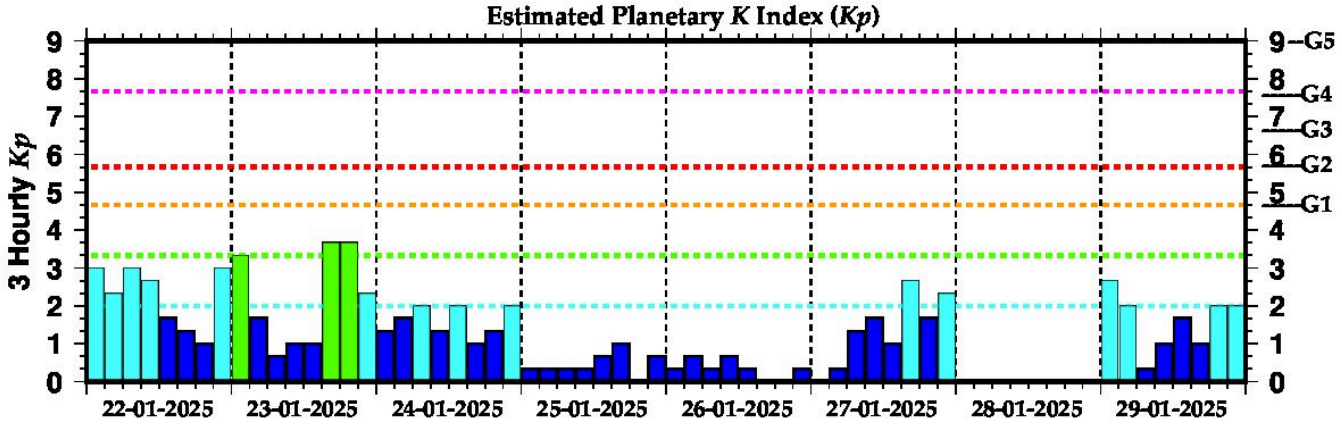

BGS Scale: *Quiet* *Unsettled* *Active* *Minor Storm* *Major Storm* *Severe Storm*

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NOAA Scale:	G0	G0	G0	G1	G2-G3	G4

Created : 29/01/25 00:00 GMT

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Radio Blackouts - X-Ray Flares

There are currently seven sunspot regions visible on the Earth-facing side of the Sun, many of which are located near the limbs, making detailed analysis challenging. AR3967, AR3972, and AR3975 are expected to rotate beyond the western limb in the coming days. Meanwhile, AR3976 and AR3977 are emerging from the eastern limb and may correspond to the previously active regions AR3947 and AR3953 from the last solar rotation. Notably, AR3976 appears to exhibit some magnetic complexity, warranting further analysis as it moves across the solar disc. The remaining sunspots are small and magnetically simple.

Trends in the coming four-day forecast period will rely on a balance between the departures of sunspot regions over the western limb, and new regions emerging over the eastern limb. Some activity has already been observed from the northeast limb with AR3976 likely responsible for the M1.7 flare at 28/1945UTC..

Overall, the daily flare risk remains steady over the coming days, with AR3976 rotating further onto the disc. Low to Moderate solar activity is expected with a chance of further isolated M-class flares and a slight chance of X-class flares.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	No	50	50	50	50
Very Active	R3-R5 (X Class)	No	5	5	5	5

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Figure 3: GOES 16 and 18 X-Ray flux

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Solar Radiation Storms (High Energy Protons)

Proton flux is currently at background levels, and is most likely to stay that way. However, there is a slight chance of it rising above the S1/Minor Radiation Storm threshold in the coming days, mainly due to AR3961 which is now over the western limb. This region will have rotated well away from the west limb by Day 2 (30 Jan) so this risk declines through the period.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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High Energy Electrons (≥ 2MeV)

High energy electron flux observed at GOES16 has been mostly at background to moderate levels over the past 24 hours, reduced from its high levels on 27 Jan. Flux levels are expected to remain at these levels through the forecast.

The corresponding 24-hour fluence is expected to remain below the Active threshold, with a gradual downward trend. MOSWOC REFM is felt to be giving reasonable guidance here, although clearly the forecast fluence is lower than currently observed.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	1	1	1	1
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

Figure 4: GOES16 Electron Flux three day plot

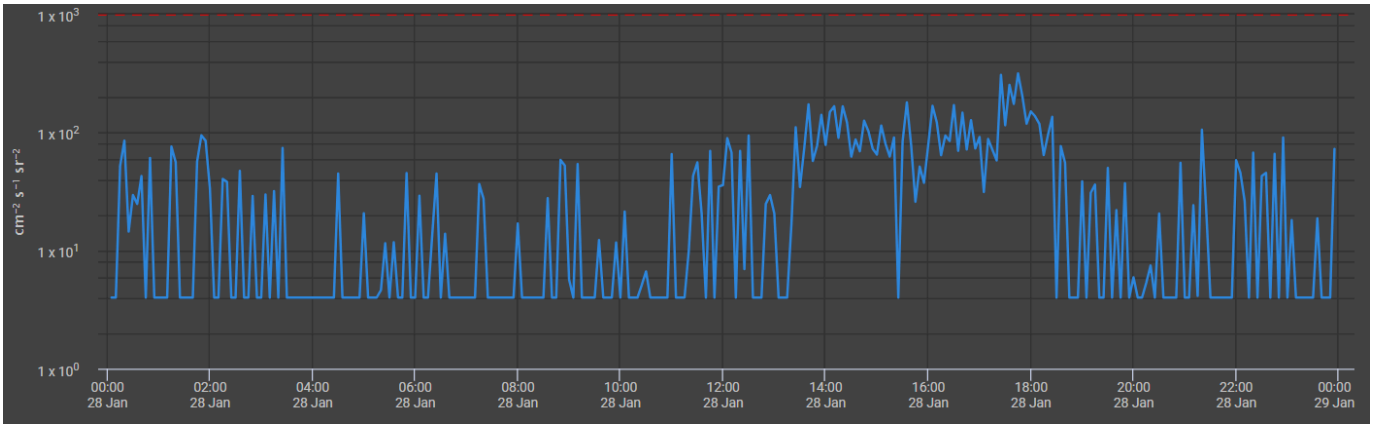

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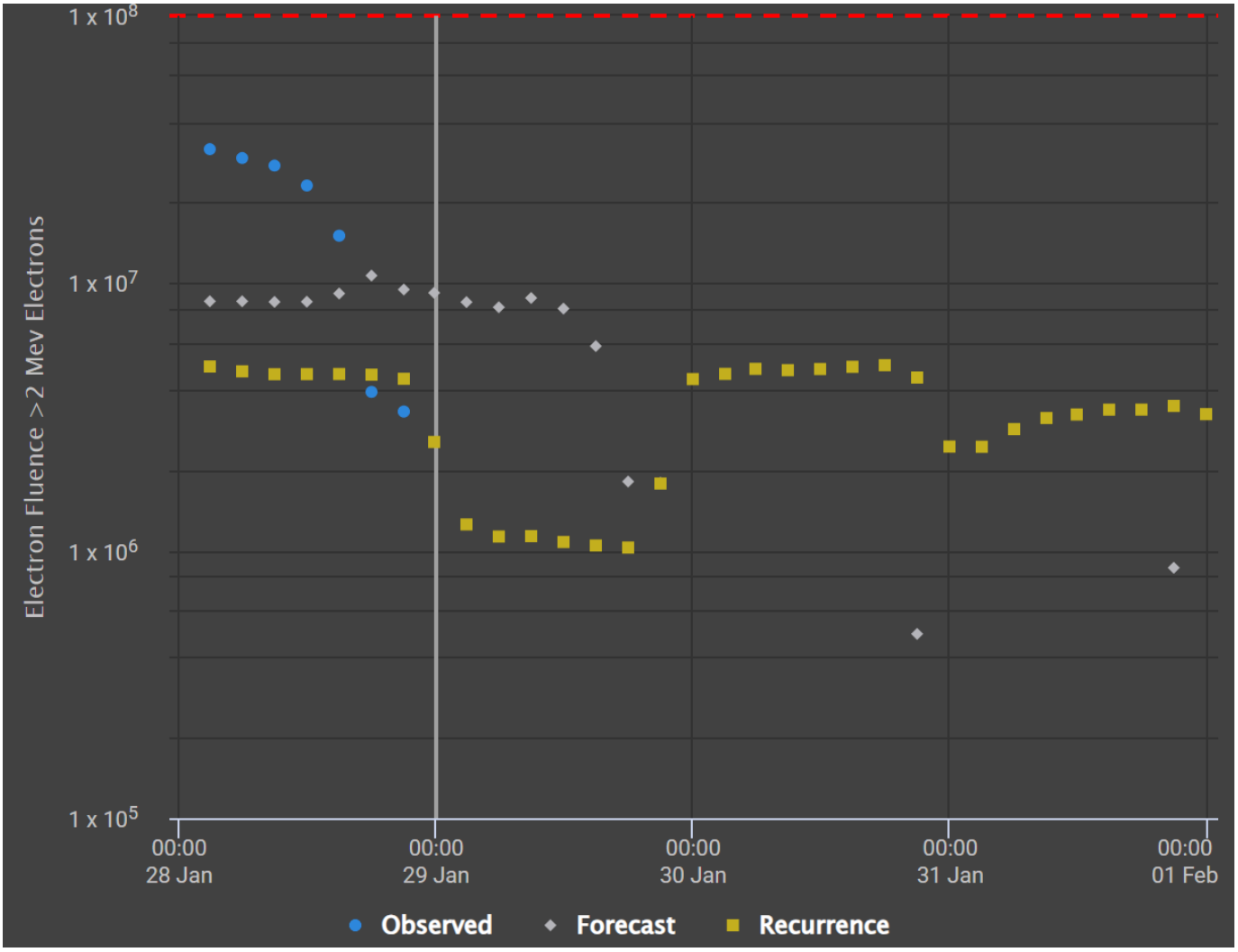
Figure 5: MOSWOC REFM



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